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# RESEARCH ON IMPROVING COMFORTABLE CABLE CAR BY LATERAL DAMPING

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***Abstract:*** *In the present article are presented the results of recordings made while traveling by cable car under disturbances caused by wind. This research trying to find a lateral oscillation damping solutions and their disposal gain due to lower pendulum arm consists of assembly cable, battery rollers, arm, and cabin. Below are the measurements obtained on a model 1:10 scale on which it was mounted an active suppression system for lateral play*
***Keywords:*** *cableway, cable, cable transportation, dampening, oscillation*

## 1. INTRODUCTION

Cable transportation is used for quick access to mountains equipped to ski slopes and connects the massive of mountains for tourist attraction. It also represents a means of travel and entertainment, having an important role in the development of mountain tourism (infrastructure tourist altitude resorts), but also for winter tourism.
Experiments remain present in the life of a cable transport installation and after its introduction into production, to check the stability of manufacturing technology, maintain quality and reliability, confirmed during certification (approval). Any changes to a product in mass production involve a review and approval based on appropriate tests.
Therefore, experimental research precede and accompany all stages of the existence of a facility, as an object of economic activity, giving original certificate of conformity with the requirements of the design project and later all certificates of maintaining technical and functional parameters to defaults, so its dynamics to maintain the desired set by the manufacturer and the customer.

## 2. INVESTIGATION OF VORTEX EXCITED CROSS-OSCILLATION OF BICABLE ROPEWAYS

Observations and reports of various aerial ropeways by operating personnel have time and again shown significant cross-oscillations of the cabins to occur and build up even during meteorologically calm periods in the absence of wind. This was described most recently in the case of bicable ropeways which were equipped with barrel-shaped cabins (circular cross-section). These oscillations always appeared only at reduced operating speeds. Similar behavior has been observed in the past for ropeways with cylindrical cabins; turbulence was clearly identified as the cause of these oscillations [3]. This led to the speculation that here, too, the forces which excite the oscillations are the result of periodic vortex forces acting on the cabin due to the relative wind. In order to confirm these suspicions, this was examined from a theoretical point of view, on the one hand, and by measurements taken of two different bicable ropeways while in operation, on the other [2]. As it is described later in greater detail, computer simulations have been carried out in the meantime regarding the behavior of the cabins when subjected to vortex effects [4].

## 3. ASPECTS FROM THE MEASUREMENTS ON THE CABLE CAR

As can be seen in article “Aspects of analog theoretical and experimental research on the dynamics of cable cars” [1] were measured accelerations were then compared with a dynamic model with 5 degrees of freedom where the results were compared with data from reality.

## 4. ASPECTS FROM THE MEASUREMENTS ON THE CABLE CAR MODEL

To achieve scale model studied different patterns of similarity and concluded that it will take part in the study similarity as to obtain a perfect similarity is necessary to make a 1:1 scale model. Thus, the cable will be made of the geometrically in a scale of 1:10, in terms of weight will be 1000 times lower than in reality. Used wire diameter will be 5 mm.

Winds will be a variable that clicks the wind distorted because the cable car to have the same effect (tilt angle) as in the real case. The calculations effectuated in Mathcad program resulted in a speed of 4.7 m/s, this speed during the tests had no effect on the cable car thus confirmed by experimental research wind speed of 4.7 m/s which reality scale model to obtain the same effect as the real model (angle of inclination of the cable car) at a wind speed of 15 m/s (Figure 5).

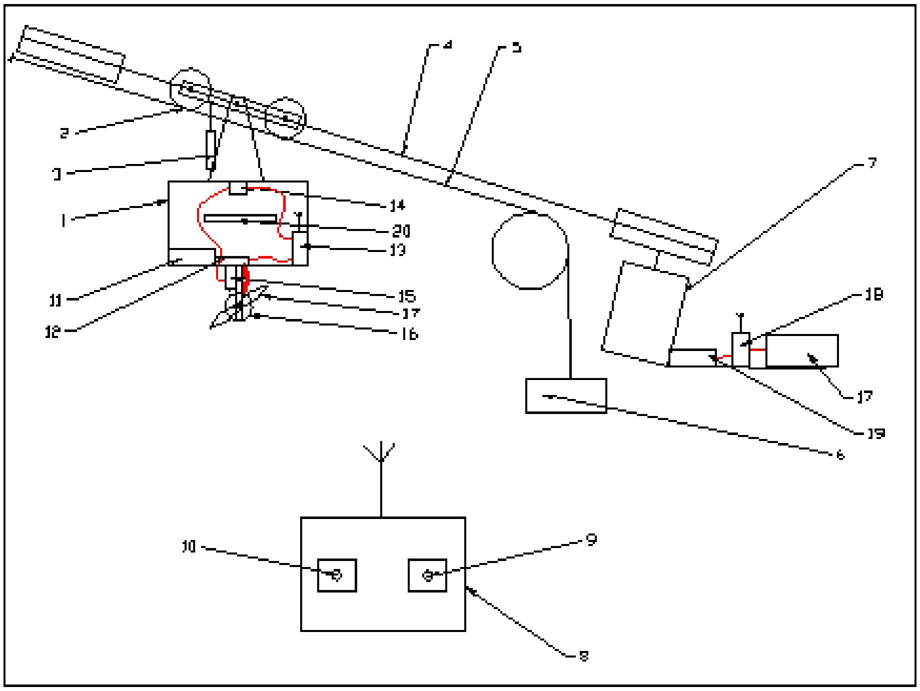
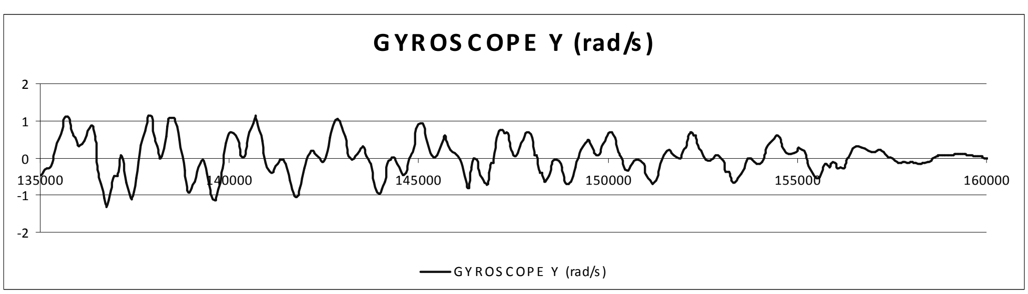



**Figure 1:** Functional diagram of experimental testing stand.

In Figure 1 we have the following components: 1 - cable; 2 - the battery roller; 3 - battery damper roller drawer; 4 - cable; 5 - cable carrier cable tension; 6 - weight carrier; 7 - cable drive motor carrier; 8 - control group transmitter; 9 - speed lever of the cable car drive motor; 10 - speed control lever of the motor 16; 11 - battery supply circuit in the cable car; 12 - motor speed controller of the motor 16; 13 - cable car radio control receiver; 14 - gyroscope control (rotation accelerometer); 15 - servo motor for variable pitch propeller; 17 - the propeller, 18 - radio receiver control group drive drawer cable; 19 - speed controller pulling group; 20 - data acquisition board.

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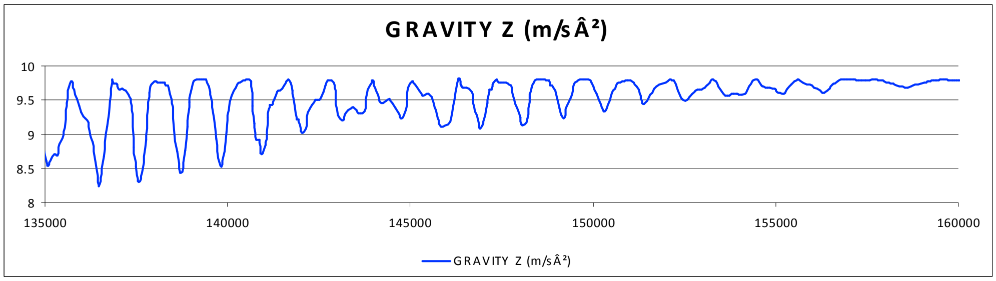


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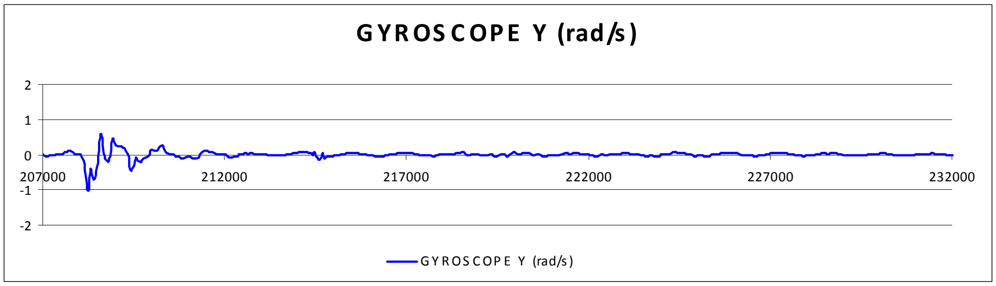
**Figure 2:** Transverse oscillations without damping cable car in the conditions of a side gust of 5.2 m/s

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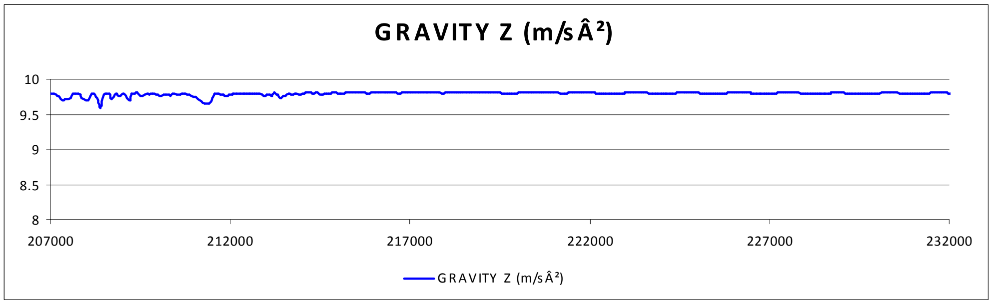
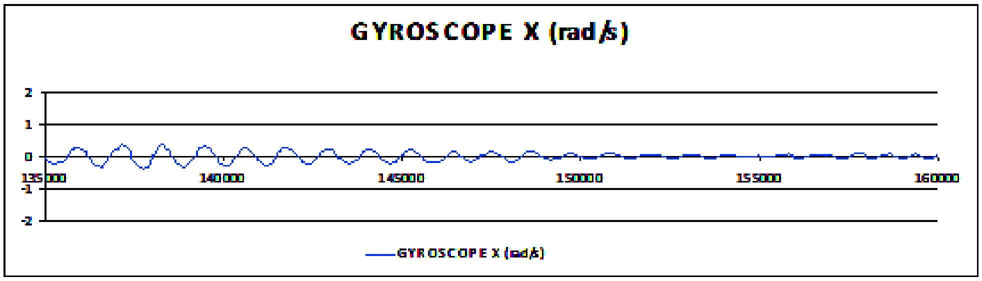



b.

**Figure 3:** Oscillations of dampened cable car in the transverse plane through controlled variable pitch rotor gyro sensor in terms of a wind of 4 m / s with gusts side of 5.2 m/s, the tension in the cable carrier 150N, 40N cable car mass, length of 20 m and a carrier difference at 5 m

In Figure 2 we can see that the decay time of oscillations cable car has just mounted a numbness between the roller and the arm cable car battery is 25 seconds, and if the cable car comfort but controlled variable pitch rotor gyro started, the timeout is 5 seconds (Figure 3) and discomfort to passengers is much lower. Figure 2, *b* can be seen as the gravitational acceleration varies passenger perception that it varies between 9.8 m/s$^2$ and 8.3 m/s$^2$.

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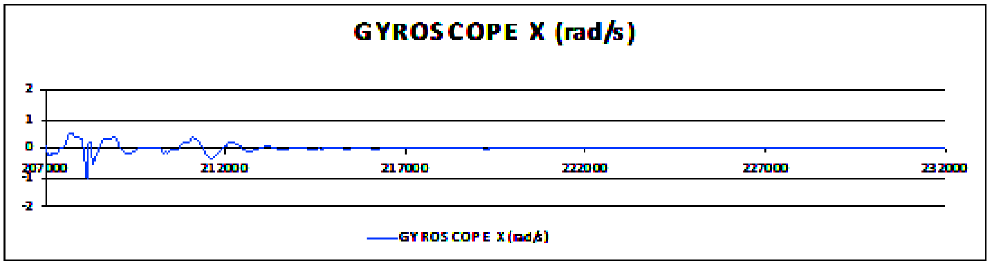


b.

**Figure 4:** Undamped oscillations in terms of lateral gusts of 5 m/s at the top of the figure and longitudinal oscillations damping cable car through the controlled variable pitch rotor gyro sensor on the same terms at the bottom

As can be seen in Figure 4 lateral damping plays an important role in the overall oscillation of the cable car because it helps to extinguish felt in the longitudinal oscillations as shown in Figure 2. Keep up the complete extinction of longitudinal balance occurs after 10 seconds and if no side damping Figure 2 below, the balance is off time of 20 seconds.

**Figure 5:** Aspects during testing with cable car crossing wind

## 5. CONCLUSION

Wide lateral oscillations of the cable car without stabilization device are switched off in 20 seconds and when it is on fire oscillations is done in 5 seconds.
Attempts were made to stabilize the engine and propeller step on the different fixed values to 0 or cabin but behaved as if a simple cable car, oscillation keeps extinguished in 20 seconds.
When crossing cable car equipped with damping device blast it If cable swing damping system balance without side pillars approach must slow down to each of them.
If cable car cable car system can prevent oscillation passes the pillars without slow down the speed of transport may increase, thus increasing the number of passengers that can be transported on an exchange.

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